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CLINICAL PAPER

Closing the knowledge—performance gap: An audit of medical management for severe paediatric trauma in Flanders (Belgium)☆

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Summary
Aims: Considerable variability in (paediatric) trauma care has been reported. We wanted to audit current practice in Flanders (Belgium).
Methods: The PENTA network prospectively collected data on paediatric trauma patients in a representative sample of Flemish hospitals during 2005. All cases with an ISS $\geq$ 13 and sufficient data availability were withheld for panel evaluation ($n = 92$). Two trained experts reviewed the medical care provided in the first hours after trauma, based on available evidence and existing universal guidelines. 'Defaults' were only withheld as such if there was 100% consensus. At random, about 25% of cases were also reviewed by two other experts in order to assess interobserver variability.
Results: In the 92 cases, 264 defaults were recognised. 25.4% of all defaults were thought to have a direct impact on the individual patient's outcome. Specific difficulties were observed with, e.g. cervical spine management (18/82 relevant cases), pCO_2 and global respiratory management (38/92), fluid management (29/92) and analgesia (27/89). The agreement between the two panels was good for defaults identified (crude agreement 74.8%), yet only fair for the presumed impact on outcome (crude agreement 58.3%).
Conclusions: We audited paediatric trauma care in Flanders and identified several problem areas (often in basic areas of paediatric life support). The inherent degree of interobserver

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variability does not diminish the importance of these findings. More performance-based teaching and timely recertification may have a positive impact on the quality of the care delivered.

Introduction

> ''The profession can no longer hold privileges against both public and patient criticism without demonstrating clearly that we have the capacity to be critical of our practice, of our teaching, and of the prevention of errors, or inadequacies in our performance'' (Duthie, 1993).[1]

Variability is reported in the delivery of virtually every aspect of health care. Often the care delivered seems inconsistent with available guidelines or current evidence.[2–4] Performance improvement has an important positive impact on the patient's outcome.[5] Closing the knowledge—performance gap is thus considered one of the most important challenges for the medical profession in the forthcoming years.[6–8] Awareness is the first and crucial step in achieving this goal. In this respect, medical audit is of the utmost importance.[9] The aim of this study was to audit current medical care delivered to paediatric trauma patients in Flanders (Dutch-speaking northern part of Belgium) and identify possible areas susceptible for improvement.

Methods

The PENTA registry prospectively collected data on paediatric trauma patients in a representative sample ($n = 18$) of Flemish hospitals during 2005.[10] Ethical committee approval was obtained in each. Data were rendered anonymous before analysis. The data collection for children with severe trauma (length of hospitalisation ≥ 48 h; $n = 244$) included 291 variables providing detailed information about trauma circumstances, injury severity, patient status, and medical care delivered within the first hours after trauma (including pre-hospital care). All cases with an injury severity score [ISS] of ≥ 13 ($n = 96$) were withheld for further evaluation by panel review.[11] Two trained experts (PVDV, MD and MS, MD—Ph.D.) independently reviewed cases and then discussed each case in turn during several consensus meetings. Each reviewer received a short case description about the patient's care trajectory, severity of injuries and outcome, as well as the complete original chronological data file. To facilitate the audit process, we also provided a (not-limitative) list of audit filters (i.e. potential problem areas) (see Table 1). Reviewers were instructed to base their evaluation upon existing evidence and current guidelines, as far as these were uncontested in any recent literature.[12–14] For instance, 'steroids in spinal injury' or 'crystalloids versus colloids for resuscitation' would *not* be considered, while 'high-dose steroids in neurotrauma' or 'a dextrose solution IV for resuscitation' would. An audit filter was then withheld as ''default'' only if it was considered avoidable and not justified by circumstances; if both reviewers absolutely agreed, and if the registered data were considered sufficient to evaluate the process at hand. Whenever there was any reasonable doubt, the audit filter was not withheld as default (in dubio, abstine). Initially, ''defaults'' were identified *irrespective* of their potential impact on the patient's outcome. This impact on morbidity and mortality was afterwards scored separately as 'no impact' or 'some impact' on the outcome of that particular patient. To optimise the validity of the results, interobserver variability was assessed by reviewing 26 cases a second time with two other independent experts (PC, MD—Ph.D. and SI, MD—Ph.D.). Twenty-two cases were selected at random (Statsdirect©).[15] Two cases were added because one expert of the first panel was to some extent involved in the medical care provided; two others because of the case complexity. The modalities of the second review process were similar to the first. After their initial review, the second panel was informed about the defaults withheld by the first panel. Subsequently, both panels discussed the 26 cases to reach a final consensus. For agreement between reviewers and panels, crude agreement (in %) as well as change-corrected agreement (Cohen's kappa κ) was calculated using Statsdirect©.[15]

Results

Of the 96 identified cases, 92 were withheld for evaluation by the first panel. Two were excluded because of insufficient data; two others because they died before any medical intervention. The median ISS was 21 (interquartile range [IQR] 15), the median length of stay in hospital was 9 days (IQR 16). Fifty cases were vehicle-related accidents, 20 were falls. Approximately 70% received pre-hospital care and 78% were admitted to intensive care. The majority (75%) of cases had a good outcome, 11 children showed moderate to severe disability at discharge and 12 died.[16]

The first panel identified 264 defaults in the 92 studied cases. Only in four patients were no defaults withheld. In 15 cases there was only one default, in 28 cases two, in 21 cases three, and in as much as 24 cases there were four or more defaults identified. Defaults were recognised in the pre-hospital phase (30%), as well as in the emergency department (43%), or during the first hours after hospitalisation including during early surgery (27%).

The interobserver variability in the first panel was low with an overall crude agreement *before* discussion of 75.2% (Cohen's κ 0.50). Of the 264 defaults withheld by the first panel *after* consensus, 88% had been recognised by both reviewers independently beforehand.

One in four defaults (25.4%) was thought to have had a certain impact on the patient's outcome. Of all these latter defaults, about half were related to ''ABC'' management (airway, breathing, circulation). Figure 1 specifies the number of defaults recognised in different areas of medical care. Overall, we observed problems with analgesia in as much as 27 of 89 relevant cases (30%), problems with cervical spine management in 18 of 82 (22%), suboptimal or inadequate oxygenation and ventilation in 38 of 92 (41%)

Table 1 A not-limitative list of audit filters (i.e. potential problem areas)

- On-scene time and transport times
- Triage; appropriateness of referral
- Time spent in the emergency department
- Timing of and indications for radiology
- Time to abdominal surgery; more specifically in case of hypotension because of intraabdominal pathology
- Time to ''urgent'' vascular surgery; trauma surgery and neurosurgery (specifically for epidural haematoma)
- Appropriateness of surgery indication (including damage control surgery)
- Fracture immobilisation/fixation
- Fluid management (type, amount)/IV access — perfusion pressure
- Oxygen therapy — oxygenation
- pCO_2 management — ventilation, specifically in case of traumatic brain injury
- Airway management/intubation, specifically in patients with coma (GCS < 8)
- Temperature management, specifically in case of traumatic brain injury
- In patients with GCS $\leq$ 13: timing of CT scan, cervical spine immobilisation, monitoring
- Metabolic derangements (glucose, sodium...), specifically in case of traumatic brain injury
- Burn care
- Missed, incorrect or delayed diagnosis; procedures; including CPR
- Adequacy of materials, procedures, medication doses in view of the age of the patient
- Analgesia and sedation
- Donor selection/management
- Resource use; length of stay

and defaults in circulatory management in 29 of 92 patients (31%) (see also Figure 2). Unacceptable hypo- or hypercapnia was encountered in 14 of 66 cases (21%) at risk for intracranial hypertension.

In the 26 cases selected for second review, the agreement between both panels before discussion was found to be 'good' (crude agreement 74.8%; Cohen's κ 0.63). The agreement was, on the other hand, only 'fair' when considering the presumed impact on the individual patient's outcome (crude agreement 58.3%, Cohen's κ 0.20). After the final consensus meeting between both panels, 103 defaults were withheld. Of the 98 defaults recognised by the first panel, 12 were no longer withheld after final consensus, yet 17 others had been added.

Discussion

A need for audit?

It is the responsibility of the medical profession to evaluate the quality of care and to strive for continuous performance improvement. This has little to do with sorting out ''bad apples'', but everything to do with systematic and continual analysis of input and process of care, as well as outcome; with the intent to reduce variation in care and eventually improve patient satisfaction and outcome.[17,18] In this respect, outcome evaluation has become an inherent part of most research initiatives and to a lesser extent of routine clinical care. Assigning a specific outcome to a par-

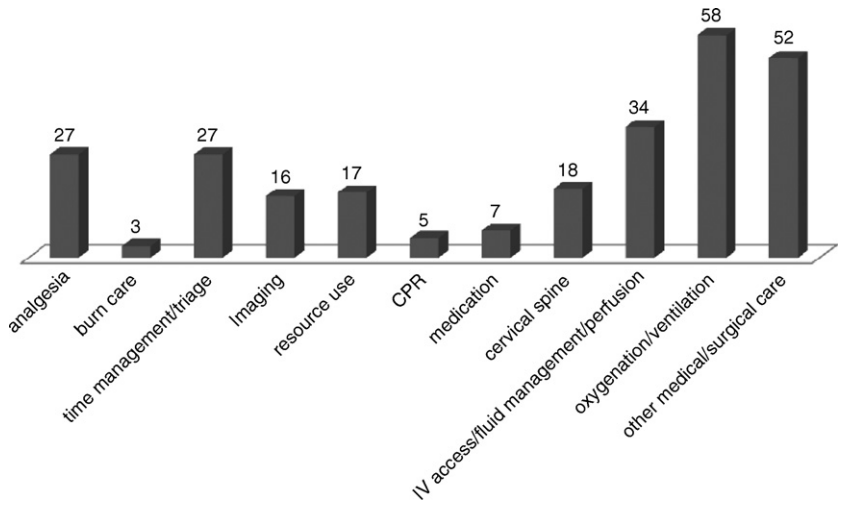

Figure 1 The absolute number of defaults (n = 264) recognised in different areas of medical care.

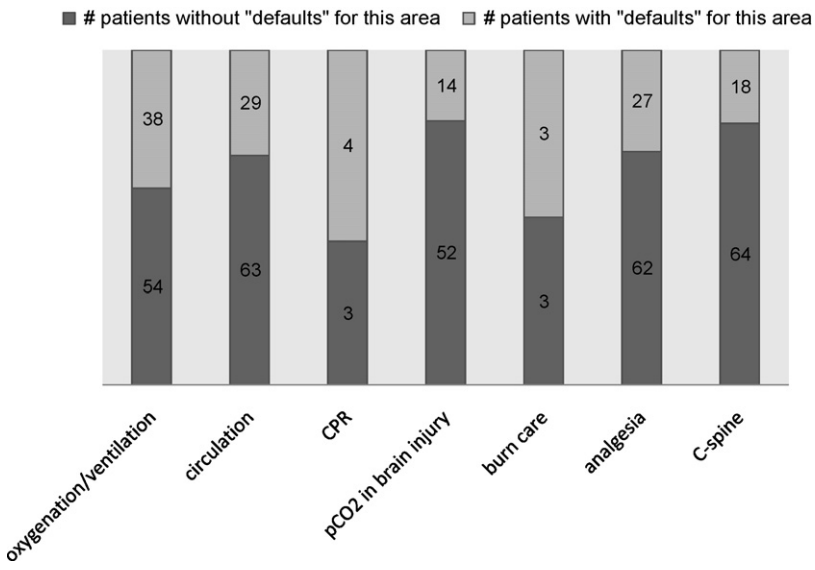

Figure 2 Numbers of patients with (light) and without (dark) a default for particular areas of medical care. For the evaluation of each area of care only relevant cases were included (light + dark, together 100%).

ticular intervention is, however, often difficult because of time effects and intervening events. Further, outcome measures are often prone to bias and may lack responsiveness with regard to system improvements.[1] Finally, bad outcome is relatively rare, so that studies trying to show important correlations are most often underpowered.

Process measures are, although not always strong predictors of outcome, clearly more controllable and more responsive to change.[19–21] However, the reliability and validity of the methodology has been questioned. Often, it is based upon implicit judgments by an expert panel which are inherently subjective with low reproducibility and not very well defined end-points.[7,22,23] Still, while lacking in quantitative precision, process evaluation has the ability to detect opportunities for improvement and to serve as a major impetus for necessary changes.[17,24,25] Historically, most of these studies evaluated preventability of mortality or morbidity. In our opinion, whether or not suboptimal care leads to certain morbidity or mortality is of secondary importance. Each of these 'defaults in care' has the potential of generating additional morbidity or mortality and should be acknowledged as such ('near-miss principle'). Although guidelines are often *not* based on much evidence and too strict adherence to existing guidelines may even obstruct evolution in medicine, it is without discussion that certain deviations from 'standard care' are indeed 'inappropriate' care. Identifying these clear deviations and the reasons for them is one of the main goals of a panel evaluation. In our audit, evaluation was based on widely accepted guidelines, as far as they were uncontested in recent literature.[12–14]

The validity of the methodology

The value of any audit is directly related to the availability of accurate and complete data. We collected these data as part of the PENTA registry in Flanders, a population-based paediatric trauma registry.[16] Data collection was exhaustive and we invested a lot of energy into data accuracy and completeness. Our study had, as has every audit, a certain resolution, related to the method of collection and the variables collected. We did not have sufficient information on (and could therefore not evaluate), e.g. treatment effects (pain relief after analgesia...), adequacy of technical procedures or communication....

Importantly, reviewers focussed only on clear ''defaults''; on significant violations of basic care principles, not on minor infractions. If there was any reasonable doubt, that default was not withheld as such (in dubio, abstine). Panel members all had ample expertise and received specific training regarding the review process. Final decisions were taken in full consensus. Interrater variability was assessed by presenting 26 cases to a second independent panel. The two cases where one member of the first panel was involved were eventually withheld because a lot of the care provided was not related to the reviewer. As only 22 of the 26 cases were selected at random, a bias in favour of disagreement was introduced. Still, the agreement between both panels (also in the not-random cases) for defaults recognised, even before discussion, was clearly 'good'. The agreement before discussion regarding the impact on outcome was, on the other hand, far less. Linking a recognised default with the outcome of an individual patient often turned out to be difficult (as we have already pointed out in the beginning of the discussion section).

Although the above data confirm the inherent degree of interrater variability associated with panel review, we feel it does not diminish the importance of its conclusions.

The importance of our findings

It is important to place our findings in the right perspective. For every default, several other actions were timely and

appropriate. On the other hand, a bias might also have been introduced because hospitals participating in our registry (18 of 71 Flemish acute care hospitals) tended to be larger and had an active interest in paediatric trauma.

The majority of the detected defaults were observed in basic areas of advanced paediatric life support (e.g. airway and cervical spine management, oxygenation, ventilation, fluid resuscitation, pain relief), in part because of the focus of this audit. These findings are not unique to trauma nor are they limited to Flanders. Several recent studies similarly show an alarmingly high degree of inappropriate care, emphasising the need for new ways of education, process evaluation and performance improvement initiatives.[25–29] Although widely used, passive dissemination of knowledge seems ineffective in improving actual medical performance.[8] More performance-based teaching has a positive effect on perceived self-efficacy and overall skills, although the evidence in favour is still limited.[30–32] Given the fact that paediatric emergencies are rare, it is likely that this positive effect diminishes over time if training is not repeated regularly.[33,34] Broster et al. showed that for a large region in the UK the majority of paediatric consultants and registrars, although at one point having attended an ALS course, did not keep up with maintaining/recertifying these skills.[35] This situation is very similar for Flanders, where there is actually no incentive whatsoever for following, e.g. an APLS/EPLS course.

It is clear that there are no easy solutions to the existing knowledge—performance gap. However, as several authors agree, on-going assessment of actual medical practice is undoubtedly the first step.[6,7,20,36] A further step could then be not only to implement a more performance-based approach to teaching but also to ensure regular recertification in view of the low rate of exposure to paediatric emergencies for most physicians.

Conclusions

We audited medical management in severe paediatric trauma victims in Flanders and identified several problem areas. Defaults were often recognised in basic areas of advanced paediatric life support (ABCD management). The inherent degree of interrater variability associated with panel review does not, in our opinion, diminish the importance of these findings. More performance-based teaching and timely recertification could be a more efficient way of providing physicians with the necessary skills to manage paediatric emergencies.

Conflict of interest

All the authors listed declare that there is no financial conflict of interest of any kind.

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The greatest of faults is to be conscious of none (Thomas Carlyle, 1795—1881).

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Appendix A

The following Flemish hospitals participated in the registry: ASZ Aalst, St. Blasius Dendermonde, UZ Gent, AZ MMSJ Gent, Jan Palfijn ZH Gent, AZ St. Lucas Gent, AZ Oudenaarde, AZ MM St. Niklaas, AZ Groeninge Kortrijk, HH ZH Menen, HH ZH Roeselare, AZ St. Maarten Mechelen, AZ St. Maarten Duffel, St. Vincentius ZH Antwerpen, Klina Brasschaat, AZ Stuivenberg Antwerpen, ZH Noord-Limburg Lommel, ZOL Genk, UZ Gasthuisberg Leuven.

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